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DETERMINANTS OF FOOD SECURITY AND COPING STRATEGIES AMONG RURAL HOUSEHOLDS IN BAKA-DAWULA ARI WOREDA, SOUTHERN, ETHIOPIA

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ABSTRACT

Purpose- Food is any substance that people eat and drink to maintain healthy and productive life as well as growth. While food security is when all peoples access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. However, now a day food security is one of the main confuse factors of economic growth of developing county in general, Ethiopia in particular. Therefore, the main aim of the study was to examine the determinants of food security and coping strategies among rural households' in Baka Dawula Ari district, Ari Zone, Southern Ethiopia regional state.

Methodology- The study employed quantitative research approach and explanatory research design. To collect data from the sample respondents of 269, multistage random sampling techniques used. For the data analysis, both descriptive statistics and econometric models particularly the logistic regression model used.

Findings- The results of logistic regression analysis indicated that age household head, education level, access to extension services, households participate in off farm activities, households ownership of oxen, livestock ownership and cultivable land size were positive and significantly influencing household food security in the study area. while, family size is negative and significantly influencing household food security in the study area. The survey result of coping strategies state that majority of household was used mechanisms such as reduced number of meals eaten in a day, selling small animals, relay on causal labor, borrow money/food from relatives and selling firewood and charcoal were used in the period of shortage of food.

Conclusion- Based on the findings, the local government development strategies need to encompass education programs; attempt short-term training center should experience in a strategic and organized to improve household education. Additionally, facilitate starting income to participate on off-farm activities, improving the quality of the land through improved soil and nutrient management to increase food production, and supply better veterinary services to improve livestock markets to achieve household food security.

Keywords: Household Food Balance Model, Food security, coping strategies, Baka Dawula Ari district, binary logit model
JEL Codes: Q18, Q12, C25

1. INTRODUCTION

1.1. Background of the Study

In the worldwide food insecurity remains a major challenge, mainly among the rural areas of developing nation. Women and children are most vulnerable to this phenomenon (Ridwan et al. 2020). Hunger and undernourishment are the main challenges of today's world, and 960 million people are hungry and undernourished (Mesfin et al. 2021). As a result, food security continues to be the greatest problem of economic development and adverse effect on public health on the globe up today (Gizachew et al. 2023). Food security exists when all people have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (Abduselam, 2017; Gizachew et al. 2023). As population of a county at all-time are available food, access food, nutritionally adequate food in terms of quantity and acceptable within the given culture the county is said to be food secure (Seid and Biruk, 2019). Additionally, households assumed food secure when they produce adequate essential food to encounter their daily needs or when they have enough income to purchase food from the market (Workineh, 2024).

The concept of food security encompasses multiple dimensions such as food availability, food access, food utilization and food stability. Food availability refers to the existence of food stocks for consumption. Household food access is the ability to acquire sufficient quality and quantities of food to meet all household members' nutritional requirements. Access to food

is determined by physical and financial resources, as well as by social and political factors. Utilization of food depends on how food is used, whether food has sufficient nutrients, and a balanced diet can be maintained (FAO, 2014). Food security issues become a critical concern and top priority for developing countries, particularly Ethiopia (Girma, et al., 2023). From Sub-Sahara African countries, Ethiopia is one of the poorest and greatest foods insecure counties (Desta and Negussie, 2017). Ethiopia is one of the countries with the most food insecurity and famines in the developing world (Adimasu et al, 2019). In Ethiopia, food insecurity is the most serious problems (Abebaw and Mesele, 2022) and development challenge after some economic recovery has shown in the county (Arragaw and Argaw, 2024). Additionally, under nutrition are significant problem of the county economic growth (Nigusu and Shewadinber, 2022).

In rural household level food security status of Ethiopian country is found to be a most horrible stage and the county confused by different factors (Wondim et al., 2022). For instance, a study conducted by Amanuel (2025) indicated that gender, educational level, farmland size, livestock holding, access to credit, improved seed, and social capital positively affect households' food security status, whereas family size, market distance, and natural shocks negatively influence food security. Additionally, education status, off-farming activities, livestock ownership, family size, farm size, number of oxen, expenditure on agricultural technology, agro ecology zone and distance from market center are statistically significant determinants of food security in terms of diet quantity (Tamene and Ermias, 2023).

As a result, several efforts have made to recover the general challenges of food security; as it is a main difficult in the rural areas of Ethiopia (Aweke et al 2022). The country's population has affected through chronic and transitory food insecurity and in the time, community becoming an increasingly severe living condition (Adimasu et al, 2019). Additionally, poor households are insufficient purchasing power to improve food security to the establishment of food coping mechanisms to alleviate insufficiency (Wuryaningsih et al. 2022). Food insecure households engaged in different coping strategies with the respective level of food insecurity from intake inedible, low-quality foods to the greatest severe of migrating and begging for food (Gizachew et al. 2023). The coping strategies is mechanisms in the time of food shortages, including the sale of livestock, productive assets, the receipt food aid, the participation in small trade, the reduction in the number of meals, temporary migration (Girma, et al., 2023).

Mostly used coping strategies rural household in Ethiopia are agricultural employment, sailing livestock, sale of wood and charcoal, small trading, residues crop and reduction of food consumption (Abdukerim et al., 2022). Additionally, household was coping food shortage by relying on less preferred and cheapest food and borrowing food to utilizing foods cope up to food shortage and starvation (Mesfin et al. 2021). In addition, reducing the number of meals, working as daily laborers, borrowing money, migrating for seasonal work, relied on food aid, dropped children from school, or sent them to live with relatives are most used strategies (Tadese and Yabsira, 2025).

1.2. Statement of the Problem

Ethiopian rural areas security at household food level issues has remained a challenging goal until today (Ahmed et al., 2018). There are numerous of influences household to put into the problem of food insecurity in rural Ethiopia. Among them sex of household head, landholding size, livestock and off farm activity are important factors (Tesfahun, 2022; Girma, et al., 2023). Additionally, family size, dependent ratio, cultivated land size, numbers of oxen and fertilizer use are factors affect household food security (Ahmed et al., 2018; Girma, et al., 2023). In addition, household head age, education level, income and grant types are other factors of household food security (Mazenda et al., 2022; Girma, et al., 2023).

Therefore, existence of various studies have been conducted on investigating the determinants of food security by employ household food insecurity access scale as an indicator of food security status measurement (Ahmed et al., 2018; Mojela et al., 2018; Adimasu et al. 2019; Mazenda et al., 2022) and giving little attention to the availability and utilization of food. As a result, those studies concentrated on the diet quantity aspect of food security and ignored the diet quality aspect of food security (Abayineh and Belay, 2017 and Abebaw and Mesele, 2022). In addition, many similar studies (Gebremariam et al., 2019; Girma, et al., 2023 and Adane et al., 2023) have been done focused on food production or availability giving little attention for access and utilization of food. However, when repeatedly exposed to recurrent drought and famine the total production is persistently inadequate to cover food requirement of the population.

Additionally, the previous studies (Abayineh and Belay, 2017; Wondim et al., 2022; Ahmed et al., 2018; Alemseged et al., 2018; Hailu, 2022; Amanuel, 2025; Abebaw and Mesele, 2022) has been overlook coping strategy by which household or community members used to meet their relief and recovery food insecurity situation. However, food security status and its coping mechanism are complex issues, and which are not the same from Household to Household within environment (Tesfahun, 2022). On the other hand, some studies (Mazenda et al., 2022; Adane et al., 2023; Tadese and Yabsira, 2025) conducted in urban case study rather than rural household food security. However, food security at the household level in the rural areas of Ethiopia has remained a challenging goal until today (Ahmed, et al., 2018).

Moreover, Household Food Balance Model the ability to establish access to productive resources such as land, livestock, agricultural inputs and family labor combined to produce food or cash. Additionally, it identified pillars of food security such

as availability, accessibility, and utilization of food (Meskerem and Degefa, 2015). Therefore, there is lack of study conducted in considering the rural farm households in the case of studies. Thus, against the above background, this study was utilizing by Household Food Balance Model (HFBM) to quantify the driving force of food security to examine the determinants of rural households' food security and enhancing coping mechanism of rural households in Baka Dawula Ari district, Ari Zone, Southern Ethiopia regional state.

1.3. Objectives of the Study

The general objective of this study was to examine the determinants of rural households' food security and their coping strategies in Baka Dawula Ari district, Ari Zone, Southern Ethiopia regional state. Specifically, this study aimed to examine the rural households' food security status in the study area, investigate the determinant factors that affecting rural household food security in the study area and identify the coping methods used by rural households in the study area.

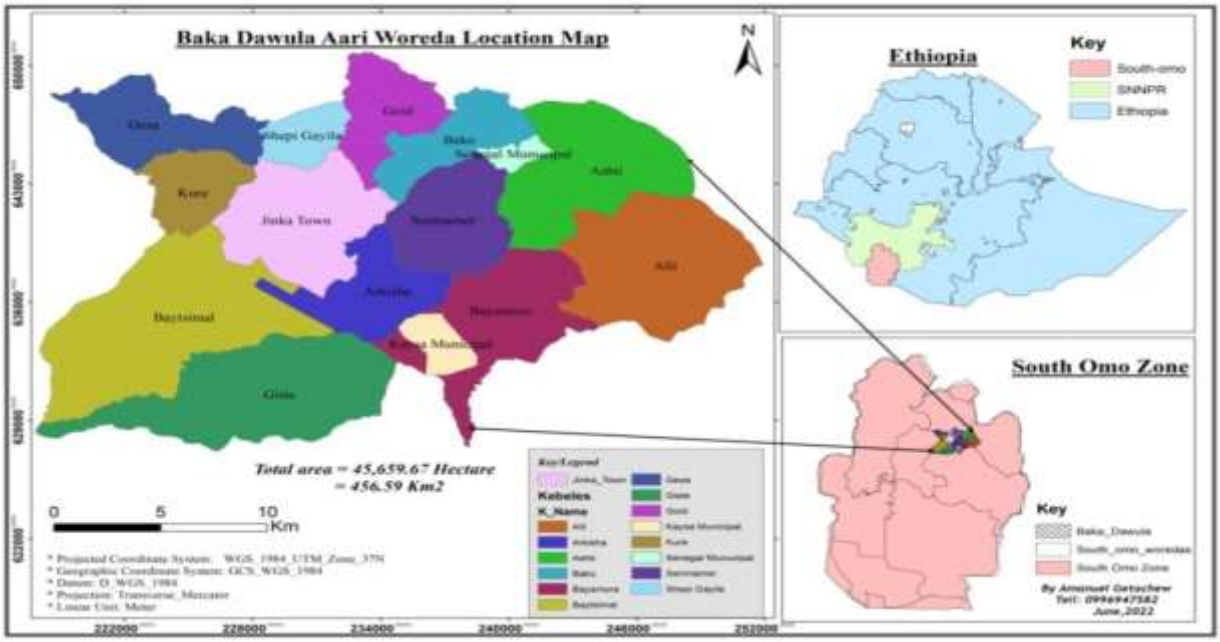
2. RESEARCH METHODOLOGY

2.1. Description of the Study Area

Geographically, Baka Dawulla Ari District, which is one of the four districts in Ari zone of Southern Ethiopian Regional state. It is bordered on the southeast and southwest by Salamago distrct specially Mago National Park, on the North by South Ari district, on the North-east by Uba Debretsehay district, most of its eastern boundary is defined by the course of the Kako River. The total population of the Baka Dawulla Ari district is estimated to be 49,623 (88.7 % rural and 11.3 % urban). In addition, the gender distribution is (male 24,663 and female 24,960). The district is sub divided into twelve (12) rural kebeles (Ari Zone Agriculture and Rural Development Office Report, 2023). Astronomical location of the district is between 4043' to 6046'North latitude and 35079' to 360.06'East longitude. It is located about in the south, 590 km from Addis Ababa by Sellam ber and 212 km from the regional city of Southern Ethiopian state Wolaita Soddo. Ari Zone has four woredas and two municipality city administrations (Ari Zone Agriculture and Rural Development Office Report, 2023).

Agro-ecologically, the landmass of the district lies between (1500–2500 Meters above sea level altitude. Annual mean minimum and maximum temperature respectively are 12ºc and 21.7 ºc. The amount of rainfall it received ranges from 977mm to 1300 mm (Ari Zone Agriculture and Rural Development Office Report, 2023). Rainfall distribution is seasonal that means the rainy seasons are Belg (February to April) and the main rainy season Meher (July to September). According to the districts Agriculture and Natural Resource Office (2023), the total area of the district estimated to be 49,659.67 hectare. The major land uses patterns are private holding (Farming), communal (grazing) and forest land. The current land use coverage's 20,258.06 (41) ha are cultivated, grazing lands is 3,121(6%) ha, Forestlands are 11,518.44 (23) ha, Marshy land is 2,375 (5%) ha and the rest 12,387.17 (25%) ha land is used for different institutions and residence of study area people.

Figure 1: Location Map of the Study Area



The farming practice in the district is mixed farming systems which are crop production and livestock keeping. The major means of livelihood in the area are subsistence rain fed agriculture, traditional weaving and involvement in off-farm activities.

The major of the district is cropping production were Maize, Wheat, Teff, Sorghum. Potato, Barely, Bean and Haricot Bean (local name Adongare) are common double-time harvesting crops per year. Additionally, coffee, chat and banana farm is more source of income of the community (Ari Zone Agriculture and Natural resource office, 2023).

2.2. Sampling Technique and Sample Size

The determination of sample size of this study is based on the formula of Yamane (1967); which is given by:

$$n = \frac{N}{1+N(e^{2})} \quad (1)$$

Where; n= sample size; N= population size and e=level of precession; e = 0.05.

$$n = \frac{959}{1+959(0.05)^{2}} = 282$$

However, data collected and analyzed in response to answer research objectives based on the responses of those selected samples with the help of a questionnaire. Therefore, a sample of the study 282 questionnaires were distributed to the respondents and out of it valid questionnaires 269 were received back properly, while 13 (4.61%) were incomplete. Thus, the questionnaire return rate was 95.39 percent, which is adequate to come up with valid study findings.

A multi-stage sampling technique was utilizing for select the household heads in the study. First, Baka Dawulla Ari woreda purposively selected from four rural woredas under Ari zone. In the second stage, 12 rural kebeles under the Baka Dawulla Ari woreda were stratifies into three strata groups (Kolla, Woyina Dega and Dega agro-ecological zones) based on their agro-ecological characteristics. Then, four rural kebeles selected based on population density and agro-ecology zones randomly. Finally, based on the total number of households in each kebeles, the number of households to be included in the study from each kebele was selecting by using proportionate random sampling technique.

Table 1: Proportionate sample size distribution

Name of kebele	Total Household in each kebele	Sample Household from each kebele	Respondent Rate
Arkisha	286	84	81
Baitsimal	232	68	68
Goid	228	67	62
Sanmamer	213	63	58
Total	959	282	269

Source: Ari Zone Agriculture and Natural resource office, 2023

2.3. Methods of Data Collection

The study was collected data from sample households by using a focus group discussion and structured questionnaire. The questionnaires were used to generate quantitative and qualitative data regarding household demographic, socioeconomic characteristics, determinants and management practices understandings of household's food security status, and coping strategies during food shortfall. To gather the information from selected respondent like Sex, Age, household size, educational status, marital status, cultivable land size, livestock and oxen owner, the access to credit, access to extension service, adaptations of improved technologies, quantity of food item and main reasons to food shortage was collected using a structured closed and open ended questions.

2.4. Method of Data Analysis

In this study, descriptive and econometric data analysis methods were used. The descriptive statistics of this study explained the socioeconomic, institutional and demographic characteristics of the farm households in the study area. Descriptive statistical tools such as mean, percentage, frequency, standard error, standard deviation, minimum, and maximum were analyzing after the data collected, edited, coded, and labelled. The chi-square (χ2) and Student's t-test were used to test the statistical significance of the dummy and continuous variables.

2.4.1. Measurement of Food Security Status

The study was using Household Food Balance Model identified from the theoretical and empirical literatures. To identify the food secure and insecure households, household food balance sheet was employed. In the calculation of kilocalories intake, the amounts of calorie available to a household were determined through an equation termed as household food balance model (Eq. (1)), which was later used for different studies Abayineh and Belay (2017) and Hailu, (2022).

Household food balance model is expressed as:

$$NG_i = (PR_i + PU_i + FW_i + RG_i) - (CL_i + CS_i + TM_i + SE_i + PB_i) \quad (2)$$

Where, the index i runs for 1, 2,…, 269 sample household of the study,

NG_i is net grain food available for household i, PR_i is total grain produced by household i, PU_i is total grain purchased by household i, FW_i is total grain obtained through food-for-work by household i, RG_i is total relief grain food received by household i, CL_i is post-harvest crop losses to household i, CS_i total crop utilized for seed by household i, TM_i is total marketed output by household i, SE_i is grain used for social events by household i and PB_i is repayment of grain borrowed by household i.

Finally, food security in the present study was measured into the following four steps. The first, net grain accessible for each household in kilogram (NG_i) was changed into corresponding total kilocalories using conversion factors of Ethiopia. Second, the food supply at the household level calculated in first step was used to compute calories available per person per day for each household. Third, following Ethiopian food security strategy, 2,100 kcal calories per person per day were used as a measure of calories required to enable an adult to live a healthy and moderately active life. Then, using 2,100 kcal calories as cut off point, a household whose available daily per capita calories is getting 2,100 kilocalorie and above are food secured (which take 1), while a household who get less than 2,100 kcal calories was considered as food insecure (which take 0).

2.4.2. Econometric Model Specification

Three models have been proposed for estimating binary choice models: the linear probability model, logit, and Probit models represented by a linear probability function, logistic distribution, and normal distribution function, respectively (Gujarati, 2013). In principle, one can substitute the probit model for logistic model, as their formulations are quite comparable; the main difference is that the logistic model has slightly flatter tails than the cumulative normal distribution, i.e., the probit curve approaches the axes more quickly than the logistic curve (Gujirati, 1995). On this score, the logit model is generally used in preference to probit. It also noted that the logistic distribution has an advantage over the others in the analysis of dichotomous outcome variables, because it is extremely flexible and easily used model from the mathematical point of view and results in meaningful interpretations (Gujarati, 2013). Therefore, the logistic model was selected for this study.

The Gujarati (2013) logit model is expressed as follows by

$$P_i = E\left(Y = {}^{1}/_{X_i}\right) = \frac{1}{1+e^{-(\beta_0+\beta_1 X_i)}} \tag{3}$$

For ease of exposition, Eq. (2) can be expressed as:

$$P_i = \frac{1}{1+e^{-Z_i}} \tag{4}$$

Where, $Z_i = \beta_0 + \beta_1 X_i$. If P_i, is the probability of being food secure, then the probability of being food insecure is given by $1 - P_i$, which is expressed as follows by Eq. (4):

$$1 - P_i = \frac{1}{1+e^{Z_i}} \tag{5}$$

Therefore, take the ratio of the probability of an event happening (P_i) to the probability of an event not happening ($1 - P_i$) and the resulting ratio is called odds ratio, this can be written as Eq. (5):

$$\frac{P_i}{1-P_i} = \frac{1+e^{Z_i}}{1+e^{-Z_i}} = e^{Z_i} \tag{6}$$

Where, ${}^{P_i}/_{1-p_i}$ is simply the odds ratio in favor of food security; the ratio of the probability that the household will food secure to the probability that it will food insecure.

Taking the natural log of Eq. (5) above, it is possible to arrive at a log of odds ratio, which is linear not only in X_i, but also in the parameters.

$$L_i = \ln\left(\frac{P_i}{1-P_i}\right) = Z_i = \beta_0 + \beta_1 X_i \tag{7}$$

Where, L_i is log of odds ratio; P_i is the probability of being food secure ranging from zero to one; Z_i is a function of n-explanatory variables (X_i) and is expressed as Eq. (7):

$$Z_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots\ldots + \beta_n X_n + \varepsilon_i \tag{8}$$

Where, β_0 is the intercept or constant term; β_1, β_2……β_n are the slope of the equation in the model (parameters to be estimated).

Finally, an empirical model for the determinants of rural households' food security was specified as follow:

$$\begin{aligned} HFS_i = \beta_0 + \beta_1 AGE_i + \beta_2 SEX_i + \beta_3 CRP_i + \beta_4 EDU_i + \beta_5 FMZ_i + \beta_6 DPR_i + \beta_7 OFA_i + \\ \beta_8 CLS_i + \beta_9 TLU_i + \beta_{10} NOX_i + \beta_{11} FTU_i + \beta_{12} AES_i + \beta_{13} LTS_i + \varepsilon_i \end{aligned} \tag{9}$$

Where, HFS_i is Household Food security status, AGE_i is Age of Household Head, SEX_i is Sex of the household head, CRP_i is Credit Participation, EDU_i is Education level, FMZ_i is Family size, DPR_i is Dependency ratio, OFA_i is Off–farm activities, CLS_i is Cultivated land Size, TLU_i is Tropical livestock unit, NOX_i is Number of oxen owned, FTU_i is Fertilizer uses and AES_i is Access to Extension Service, LTS_i is Land tenure security.

Table 2: Description of Variables and Expected Relationship

Covariates	Description of Variables	Measurement	Expected Sign
HFS_i	Dummy variable Food security status	1 if secure, &0 otherwise	
AGE_i	Age of Household Head	Continuous	$+$
SEX_i	Sex of the household head	1 if male, &0 otherwise	$\pm$
CRP_i	Credit Participation	1 if participated, &0 otherwise	$+$
EDU_i	Education level	Continuous	$+$
FMZ_i	Family size	Continuous	$-$
DPR_i	Dependency ratio	Continuous	$-$
OFA_i	Off–farm activities	1 if participated, &0 otherwise	$+$
LTS_i	Land tenure security	1 if tenure, &0 otherwise	$+$
CLS_i	Cultivated land Size	Continuous	$+$
TLU_i	Tropical livestock unit	Continuous	$+$
NOX_i	Number of oxen owned	Continuous	$+$
FTU_i	Fertilizer uses	1 for users, & 0 otherwise	$+$
AES_i	Access to Extension Service	1 if access, & 0 otherwise	$+$

3. RESULTS AND DISCUSSION

3.1. Household Food Security Status

The study measure household food security status by using household food balance model, 2,100 kcal calories per person per day were used as a measure of calories required as cut off point, a household whose get daily per capita calories are food secured and household whose get less than cut off point are food insecurity status. Based on this procedure, 114 sample households were to be able to meet the minimum subsistence requirement. The mean dietary energy available for food secured households was 2512.679 kcal calories per person per day adult equivalent, while 1275.17 kcal calories per person per day adult equivalent for the insecure group households. It showed that the mean of dietary energy supply for food secure households was larger than that of food insecure groups. Their mean difference between the two groups was statistically significant at ($p<0.01$).

Table 3: household food security status

Households	Mean	Std. Dev.	Minimum	Maximum	T-value
Food secure (n= 114)	2512.679	626.3377	2140.349	7523.336	-23.2423***
Food insecure (n= 155)	1275.17	187.0951	1030.312	2070.897	
Total (n=269)	1799.616	748.9207	1030.312	7523.336	

Source: Survey data by authors

3.2. Descriptive Result of Categorical Explanatory Variables

The results of the descriptive statistics of categorical variables such as sex, household head, credit access, and land tenure security and fertilizer user revealed that there are insignificant difference among food insecure and food insecure households. However, the two groups found to differ significantly in their access to extension services and off-farm participation households are significant difference between food secure and food-insecure households.

Based on descriptive statistics, out of the food secure households, 70 (61.4%) households were received an extension service, while the rest of 44 (38.6%) did not receive extension services. On the other hand, about 70.32% of the food insecure household did not receive extension services while 29.68% of insecure households had access to extension services. Furthermore, this imply that more food insecure household not get extension services the chi-square test for this variable shows a significant difference between food secure and food-insecure households ($\chi 2 = 26.96$).

Table 4:Descriptive result for dummy variables

Variables	Food Secured (N=114)		Food insecured (N=155)		Chi-square test
	Frequency	Percent	Frequency	Percent	
Sex (if male)	102	89.47	139	89.68	0.0029
Credit access (if yes)	44	38.60	58	37.42	0.0387

Land tenure security (if secured)	104	91.23	131	84.52	3.0450
Off-farm income (if yes)	51	44.74	47	30.32	5.8932**
Extension contact (if yes)	70	61.40	46	29.68	26.9571***
Fertilizer user (if yes)	52	45.61	83	53.55	1.6541

Sources: own survey Note: *p<0.05, **p<0.01 & ***p<0.001

As indicated descriptive statistics result, out of the food secure sample households, the proportion of households are off-farm activities participant was 44.74 percent while, only about 30.32 percent of households food insecurity were participate on off-farm activity. The result implies that most food insecure household was not participating on off-farm activity. The chi-square value also confirmed a significant difference between food-secure and insecure households with respect to access to non-farm activities ($\chi 2 = 5.89$).

3.3. Description Result of Continuous Variables

Moreover, the descriptive results for continuous revealed variables such as age of household head, education level of households, family size, land holding, cultivated land size, number of livestock and number of Oxen is significant difference between food secure and food-insecure households. The survey result indicated that on average the proportion of education food secure household heads were larger than the proportion of education food insecure household heads. Finally, the t-test is this variable is statistically significant difference between the two groups in terms of years of study at 10% level of significance.

Table 5: Descriptive results for continuous variables

Variables	Food secured	Food insecured	T-test
	Mean	Mean	
Age of household head	49.79	46.56	-3.1406***
Education level	2.03	2.27	1.6100*
Family size	7.59	8.08	2.6526***
Land holding	3.45	3.09	-1.8386**
Cultivated land size	2.13	1.26	-3.5318***
Dependency ratio	1.13	1.03	-0.6768
Number of livestock	22.28	13.68	-6.9923***
Number of Oxen	4.33	2.53	-7.6841***

Sources: own survey Note: *p<0.05, **p<0.01 & ***p<0.001

Moreover, the survey result shows, the mean 3.45 household are holding of land were food secured household heads, while household heads 3.09 household were land holding. The results of the statistics of the t-test revealed a statistically significant difference between the two groups in terms of the holding of land in the study area (t-value = -1.8386). Additionally, the mean cultivated land size are 2.13 hectares were cultivated by food secured household heads, while food insecure household heads cultivate 1.26 hectares cultivated land size. The results of the statistics of the t-test revealed a statistically significant difference between the two groups in terms of the cultivated land size in the study area (t-value = -3.5318). This result support that farmers who have larger cultivated land size are more likely to be food secure than those who cultivated smaller land size due to the fact that there is high possibility to produce more food.

According to the results of the descriptive statistics, the average family size for secured food secured and food insecure households was 7.59 and 8.08, respectively. The statistics of the t-test show statistically significant differences in the family size for food secure and insecure households in the study area (t-value = 2.6526).

Additionally, oxen ownership is also an important variable in the study areas that almost entirely rely on traditional farming methods, thereby significantly affecting households crop production. Oxen the sole provider of draft power and determinant of on time land preparation, is not uniformly distributed between food secure and insecure households. The average number of oxen owned by food secure was 4.33, while the average number of oxen owned by food insecure was 2.53, respectively. The result of the t-test indicated a significant difference between food security and food insecurity in oxen ownership at a 1% significance level (t-value = -7.6841).

Livestock play an imperative role to the households' food security through increasing purchasing power of household to buy food from market. Livestock considered as a means of food security and means of coping mechanism during crop failure. Number of Livestock (Excluding oxen) was difference between food secure and insecure households. On average households food secure have 22.28 livestock, while food insecure households have 13.68 livestock. Furthermore, the result of the t-test confirmed statistically significant mean differences between the two groups at 1% level of significance (t-value = 1%).

3.4. Econometric Results

The results of logistic regression showed that variable such as age household head, education level, access to extension services, households participate in off farm activities, households ownership of oxen, livestock ownership and cultivable land size were positive and significantly influencing household food security in the study area. On the other hand, family size is negative and significantly influencing household food security in the study area.

Table 6: The Binary Logistic Regression Model Result of Food Security Determinants Result

Variables	Coefficient	Std. Err.	Z	P>|z|	Odds ratio
Age household head	.0450687	.0212341	2.12	0.034**	1.0461
Sex	-.60387	.5944209	-1.02	0.310	.5466918
Educational level	.5870828	.140122	4.19	0.000***	1.798734
Family size	-.2502614	.1237289	-2.02	0.043**	.7785972
Access to extension services	1.689036	.3820694	4.42	0.000***	5.414261
Land tenure security	.7178342	.6371967	1.13	0.260	2.049989
Off farm participate	1.119204	.3850455	2.91	0.004***	3.062416
Number of Oxen	.3458699	.1115266	3.10	0.002***	1.413219
Number of livestock	.0614106	.0229687	2.67	0.008***	1.063335
Credit access	.0770811	.3819348	0.20	0.840	1.08013
Dependency ratio	.1963739	.1692149	1.16	0.246	1.216982
Cultivated land size	.4331343	.2217647	1.95	0.051*	1.542083
Fertilizer user	-.4812896	.3887653	-1.24	0.216	.6179859
_cons	-7.239629	1.764592	-4.10	0.000***	.0007176
Number of obs = 269	LR chi2(13) = 144.04		Prob > chi2 = 0.0000		
Log likelihood = -111.3008	Pseudo R2 = 0.3929				

Notes: *** p < 0.01, ** p < 0.05, * p < 0.1; Dependent variable: =1 if the household is food secured, 0 otherwise.

Age household head: The age household head was found to be positive and statistically significant at five percent level of statistical significant. The positive relationship implies that, the oldest households is more life experience to improve food production to access food. The implication is that, keeping other factor constant, as the age household head increase by one year the probability of household being food secures increases by a factor of 1.0461. The results were similar to study conducted by Seid and Biruk (2019); Abebaw and Mesele (2022); Wondim et al. (2022).

Family size: The coefficient of family size was found to be negative and statistically significant at five percent level of statistical significant. This indicates household that has more family size probably food insecure from those small family size household head. Citrus paribus, a small family member to household probability of increase food secure by 77.85 percent and statistically significant at 5 percent significant level. This finding was in line with studies by Desta and Negussie (2017); Mojela et al (2018); Hailu (2022); Aweke et al. (2022); Abebaw and Mesele (2022).

Education level of the household head: The household educational status was found to be positive and statistically significant at one percent level of statistical significant. This result implies that, household heads with relatively better education are more likely to be food secure than those headed by illiterate household heads. Thus, as year of school increase by one year the probability of household to be food secure increase by 1.798 holding all other factors constant. Therefore, education levels become important factors to improve food security status. This goes in line with some previous studies (Mazenda et al., 2022; Gizachew et al. 2023; Abebaw and Mesele, 2022; Amanuel, 2025) which showed statistically significant and positive relationship between level of household head education and the probability of being food secure.

Access to extension services: The coefficient of access to extension services was found to be positive and statistically significant at one percent level of statistical significant. This indicates household that can access extension service probably food secure from those who did not get an extension service household head. Citrus paribus, a percentage increase in extension services to household probability of increase food secure by 5.414 percent and statistically significant at 1 percent significant level. This finding was in line with studies by Abayineh and Belay (2017); Adimasu et al. (2019); Wondim et al., (2022) and Girma et al (2023).

Off farm participate households: The study result showed that the effect of off-farm income on household food security was positive and statistically significant at one percent level of significance. This implies that off-farm activities are important activities done by rural households get extra income to supplement their livelihoods. Households who engaged in off-farm activities are less risk-averse than farmers without sources of off-farm income are. The result of odds ratio state that as off-farm income by one Ethiopian Birr (ETB) the probability of household in favor of being food secures to increase by 3.062 percent other factors remains constant. This result is consistent with studies conducted by Seid and Biruk (2019); Abebaw and Mesele (2022); Wondim et al. (2022); Hailu (2022); Nigusu and Shewadinber (2022). As study Abebaw and Mesele (2022)

expanding the access to off-farm activities to increase household income access food from market to improve rural food security status.

Number of oxen owned: The result of the model revealed that this variable found to be statistically significant at one percent probability level and has positive association with household food security status of rural households in study area. Oxen are important economic assets that can support households attain higher production by cultivating their land effectively and on time. Households that has more oxen is most probably being food secure. The result indicates that, as number of oxen increase by one the probability of household to be food secure increases by a 1.413 citrus paribus. This finding was in line with study conducted by Meskerem and Degefa (2015); Gebremariam et al. (2019); Tamene and Ermias (2023).

Livestock ownership: It refers to the total number of livestock measured in terms of tropical livestock units owned by the head of the household. Livestock is a source of income through the sale of livestock and livestock products, as well as a source of supplementary food. Furthermore, livestock can use as a coping strategy in the event of crop failure or other disasters. Households with greater livestock holdings are to be more food secure than those without. The study result confirmed that the effect of livestock holdings on household food security was positive and statistically significant at one percent level of significance. The odds ratio in favor an increase in livestock ownership by one being food secure was increased by 1.063 on average citrus paribus. The result is consistent with the theory and most of the findings such as the study by Desta and Negussie (2017); Alemseged et al. (2018); Gebremariam et al. (2019); Hailu (2022) and Girma, et al. (2023).

Cultivated farm landing size: Cultivated land size was positively and significantly associated to food security status of the household at ten percent probability level of significance. The positive relationship implies that, the households with more opportunities cultivate land size is improve food production to access food. The implication is that, keeping other factor constant, as the cultivated land size increase by one hectare the probability of household being food secures increases by a factor of 0.618. This result supported by the findings of Adimasu et al. (2019); Gebremariam et al. (2019); Aweke et al. (2022); Girma et al (2023); Tamene and Ermias (2023).

3.5. Households Coping Strategies to Food Shortage

Coping strategies are mechanism that household's choice in order to attain food in the period of shock has occurred at household level by household itself rather than external body. Most coping mechanism based on the household's ability and constraints as well as the availability of opportunities. Accordingly, the survey result of coping strategies majority of household was used mechanisms such as reduced number of meals eaten in a day, selling small animals like hen, sheep, goats, relay on causal labor, borrow money/food from relatives and selling firewood and charcoal were used regularly and occasionally in the period of shortage of food.

Table 7: Coping strategies of households to food insecurity

Possible coping mechanisms	Regularly		Occasionally		Never	
	Frequency	%	Frequency	%	Frequency	%
Selling small animals (hen, sheep, goats)	33	12.27	140	52.04	96	35.69
Relay on causal labor	47	17.47	124	46.10	98	36.43
Reduced number of meals eaten in a day	36	13.38	156	57.99	77	28.62
Selling firewood and charcoal	54	20.07	64	23.79	151	56.13
Borrow money/food from relatives	42	15.61	81	30.11	146	54.28
Reducing the amount of food served	16	5.95	58	21.56	195	72.49
Selling large animals (ox, bull, cow, etc)	14	5.20	67	24.91	188	69.89
Rented out land to buy food	7	2.60	105	39.03	157	58.36
Sent children to stay with relatives	12	4.46	56	20.82	201	74.72
Rely on less expensive foods	32	11.90	68	25.28	169	62.83
Reduce spending on non-food items	13	4.83	57	21.19	199	73.98
Harvest immature crop	9	3.35	71	26.39	189	70.26
Household members migrate to work	20	7.43	44	16.36	205	76.21

Selling small animals: As the survey result of coping strategies, revealed household in the study area was selling small animals like hen, sheep, and goats in the period of shortage of food. About 12.27 percent of household was use this strategy regularly, while 52.04 percent was occasionally selling small animals in the period of shock has occurred at household level. On the other hand, 35.69 percent of household was never using this strategy. A study conducted by Arragaw and Argaw (2024) the sale of livestock are the dominant coping strategies reported by 84% of households.

Relay on causal labor: this strategy is another important copy strategy in the period of shock in the study area. As survey, result indicated 124 (46.10%) household occasionally of relay on causal labor and 47 (17.47%) regularly relay on causal labor

in the period of shock. Working as daily laborers, borrowing money, migrating for seasonal work, and selling livestock or household assets are coping with food shortages; many households used strategies (Tadese and Yabsira, 2025).

Reduced number of meals eaten in a day: this strategy is most important mechanism in study area. The survey result state that majority (57.99%) of household occasionally use reduced number of meals eaten in a day mechanism in the period of shortage of food. Additionally, about 13.38 percent of household were used regularly. However, 77 (28.62%) household never reduced number of meals eaten in a day mechanism in the period of shortage of food. As a study conducted by Mojela et al. (2018), coping strategy index results showed that reduce number of meals eaten in a day used by 60% household in the period of shock.

Selling firewood and charcoal: selling charcoal is the other strategy that the households in the study area practice when there is food shortage in a household level. Form the total sampled households 151(56.13%) households responded that they never sell charcoal when there is food shortage in the household level. The result reveal that 64 (23.79%) households occasionally practice a strategy when the household face food shortage and 54 (20.07%) households regularly sell firewood and charcoal to cope with the problem of food shortage.

Borrow money/food from relatives: borrowing in other important mechanism in the period of food shortage. About 54.28 percent of sample household in the study was never borrowing money/food from relatives in the period of shock. On the other hand, 15.61 percent of household was borrowing money/food from relatives regularly; while 30.11 percent was occasionally, borrowing money/food from relatives in the period of shock has occurred at household level. The study conducted by Mesfin et al. (2021) community was coping food shortage by borrowing food to utilizing less preferred foods to cope up food shortage and starvation.

Reducing the amount of Food served: this mechanism was also another mechanism in the period of food crisis. A survey, result indicated that 58 (21.56%) household occasionally reduce the amount of food served and 16 (5.95%) regularly reduce the amount of food served in the period of food shortage. As a study by Gizachew et al. (2023) fewer-quality foods is most severe mechanism to improve during food shortage.

Selling large animals: large animals like ox, bull, cow, are also important factors to solve the problem of food crisis. Based on survey result, about 5.20 percent of household was use this strategy regularly, while 24.91 percent was occasionally selling large animals in the period of shock has occurred at household level. On the other hand, 69.89 percent of household was never using this strategy.

Rented out land to buy food: this mechanism was also another mechanism that rural household used in the period of food crisis. Renting land mechanism used occasionally by 39.03% household, while about 2.60% of household was used regularly at the period of food shortage in the study area.

Sent children to stay with relatives: sent children to stay with relatives is another copy strategy that rural household used in the period of shock in the study area. As survey, result indicated 56 (20.82%) household occasionally sent children to stay with relatives and 12 (4.46%) regularly sent children to stay with relatives in the period of shock. Some households also dropped children from school, or sent them to live with relatives (Tadese and Yabsira, 2025).

Rely on less expensive foods: rely on less expensive and less preferred food is other copy strategy that rural household used in the period of food shortage. About 62.83 percent of sample household in the study was never rely on less expensive and less preferred food in the period of shock. On the other hand, 11.90 percent of household was rely on less expensive and less preferred food regularly; while 25.28 percent was occasionally, rely on less expensive and less preferred food in the period of shock has occurred at household level. As a study conducted by Mojela et al., (2018) rely on less expensive and preferred food has been used by 86% of the population to coping food crisis.

Reduce spending on non-food items: As the survey result of coping strategies, revealed household in the study area was, reduce spending on non-food items in the period of shortage of food. About 4.83 percent of household was use this strategy regularly, while 21.19 percent was occasionally reduce spending on non-food items in the period of shock has occurred at household level. On the other hand, 73.98 percent of household was never using this strategy.

Harvest immature crop: harvesting immature crop is one of the mechanism that practiced by the households in the study area during food shortage in the household level. From the total sampled households, 189(70.26%) households responded that they never harvest immature crops, 71(26.39%) households occasionally harvest immature crop during food shortage in the household level and the remaining 9(3.35%) households regularly harvest immature crop to overcome the problem of food crises.

Household members migrate to work: Household members migrate to work find income to improve food crisis. About 76.21 percent of sample household in the study were never household members migrate to work in the period of shock. On the other hand, 7.43 percent of household was household members migrate to work regularly; while 16.36 percent was occasionally, household members migrate to work in the period of shock has occurred at household level. As a studies

conducted by Tadese and Yabsira (2025); Gizachew et al. (2023), the most severe of coping strategy is migrating and begging for food.

4. CONCLUSION AND RECOMMENDATION

4.1. Conclusion

Food security remains an issue in Ethiopia particularly in the rural households. It is one of the greatest challenges for today's population and future generations. Hence, the main objective of the study was to examine the determinants of rural households' food security and their coping strategies in Baka Dawolla Ari district, Ari Zone, Southern Ethiopia regional state. The descriptive analysis of the study revealed that about 57.62 percent and 42.38 percent of the sample households were food insecure and food secure, respectively. Description result revealed that male and female household headed in the food secure sample households were 89.47 and 10.53 percent, respectively, while about 89.68 percent and 10.32 percent of the food insecure households were male and female, respectively.

On the other hand, average proportion of education level of household heads that can be food secure was larger than the proportion of educational level food insecure household heads. From all respondents of household heads, about 37.92 percent of them had access to credit, whereas 62.08 percent from those who had no access to credit service. About 38.92% household heads food secured had access to credit where as about 37.42 percent were access to credit from household heads food in secured and there is no statistical difference in age between the two groups.

Additionally, descriptive analysis of the study revealed that farmers who have larger cultivated land size are more likely to be food secure than those who cultivated smaller land size due to the fact that there is high possibility to produce more food. In addition, about 61.40% of the food secured and 29.68% of food insecure households had access to extension services. This implies those households that accesses to extension services are greatest probability to be food secure. According to the survey results of the study from the sample households' food security 44.74 percent of the household members participate on off-farm activity where, only about 30.32 percent of household's food insecure were participate and about 69.68 percent did not involve in off-farm activities.

Moreover, oxen ownership is also an important variable in the study areas that almost entirely rely on traditional farming methods, there by significantly affecting household's crop production. Oxen the sole provider of draft power and determinant of on time land preparation, is not uniformly distributed between food secure and insecure households. The average number of oxen owned by food secure households is larger than the food insecure. Additionally, livestock play an imperative role to the households' food security through increasing purchasing power of household to buy food from market. Number of livestock (excluding oxen) was on average food secure households have 22.28 livestock while food insecure households have 13.68 livestock.

As the survey of coping strategies result revealed that occasionally majority of household use reduced number of meals eaten in a day (57.99%) mechanism in the period of shortage of food. Additionally, the second and third copy mechanisms used by sampled household in study area are selling small animals like hen, sheep, goats and relay on causal labor by 52.04% and 46.10%, respectively. In addition, copy mechanisms used occasionally by sampled household in study area are selling firewood and charcoal (23.79%); borrow money/food from relatives (30.11%), reducing the amount of food served (21.56%), and selling large animals (24.91%) are important copy mechanisms. Moreover, rented out land to buy food (39.03%), sent children to stay with relatives (20.82%), rely on less expensive foods (25.28%), reduce spending on non-food items (21.19%), harvest immature crop (26.39%) and household members migrate to work (16.36%) are copy strategy used occasionally by household in the study area.

Additionally, regularly sample household used mechanism such as selling small animals (12.27%), relay on causal labor (17.47%), reduced number of meals eaten in a day (13.38%), selling firewood and charcoal (20.07%); borrow money/food from relatives (15.61%), reducing the amount of food served (5.95%), and selling large animals (5.20%) are important copy mechanisms. Moreover, rented out land to buy food (2.60%), sent children to stay with relatives (4.46%), rely on less expensive foods (11.90%), reduce spending on non-food items (4.83%), harvest immature crop (3.35%) and household members migrate to work (7.43%) are copy strategy used regularly by household in the study area.

The results of logistic regression analysis indicated that age household head, education level, access to extension services, households participate in off farm activities, households' ownership of oxen, livestock ownership and cultivable land size were positive and significantly influencing household food security in the study area. On the other hand, family size is negative and significantly influencing household food security in the study area.

4.2. Recommendations

Based on the findings of the study, the following recommendations are forwarded to improve household food security in study area. Livestock holding is important factor affecting food security positively because livestock is an important source of

wealth that could contribute to food security in the study area. Therefore, the livestock sector should strengthen through rearing, establishment of better management, veterinary services and improve livestock markets.

As household education level is positively affecting food security, in order to bring food security at the household level, the woreda development strategies need to encompass education programs to the smallholders.

Additionally, an extension service is boost food security of household. Therefore, short-term trainings that attempted in farmers training center should experience in a strategic and organized way whenever necessary.

Cultivated land was to be directly related and positively to food security of households in the study area. As a result, emerging farming training to reduce land fragmentation and improve production. Therefore, the possible measures that can undertake to achieve this strategy include improving the quality of the land through improved soil and nutrient management, promotion of labor-intensive technologies, using improved seed and creation of labor-intensive rural employment opportunities in the short-to-intermediate terms.

When off farm activities is an important factor of household food security, as a result, give training on off-farm activities and facilitate starting income to improve rural households get extra income to supplement their livelihoods.

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